AMERICAN ENGINEERING TESTING, INC.

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REPORT OF PRELIMINARY GEOTECHNICAL EXPLORATION AND REVIEW

Centennial Industrial Park

Isanti Parkway & East Dual Boulevard
Isanti, Minnesota

AET Project No. 26-00389

Date:

July 21, 2011

Prepared for:

City of Isanti
C/O Bolton & Menk, Inc.
7533 Sunwood Drive NW, Suite 206
Ramsey, MN 55303

www.amengtest.com

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July 21, 2011

City of Isanti
c/o Bolton & Menk, Inc.
7533 Sunwood Drive NW
Ramsey, MN 55303

Attn: Kevin Bittner

RE: Preliminary Geotechnical Exploration and Review
Centennial Industrial Park
Isanti Parkway & East Dual Boulevard
Isanti, Minnesota 55040
AET Project No. 26-00389

Dear Mr. Bittner:

American Engineering Testing, Inc. (AET) is pleased to present the results of our preliminary subsurface exploration program and geotechnical engineering review for your industrial park project in Isanti, Minnesota. These services were performed according to our proposal to you dated June 23, 2011.

We are submitting three copies of the report to you – one electronic copy and two hard copies.

Please contact me if you have any questions about the report. I can also be contacted for arranging construction observation and testing services during the earthwork phase.

Sincerely,
American Engineering Testing, Inc.

Rob Flickinger
Senior Engineer/Project Manager
Phone:651-659-1301
Fax: 651-659-1379
rflickinger@amengtest.com

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City of Isanti
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7533 Sunwood Drive, Suite 206
Ramsey, Minnesota 55303

Attn: Mr. Kevin Bittner

Prepared by:

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Senior Engineer

Peer Review Conducted By:

Steven D. Koenes, PE
Principal Engineer

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota

Date: 7/21/11 **License #: 13180**

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AET Project No. 26-00389

PRELIMINARY GEOTECHNICAL EXPLORATION AND REVIEW FOR CENTENNIAL INDUSTRIAL PARK ISANTI PARKWAY & EAST DUAL BOULEVARD ISANTI, MINNESOTA AET PROJECT NO. 26-00389

1.0 INTRODUCTION

You are proposing to construct a new industrial park at a site in Isanti, Minnesota. To assist planning and design, you have authorized American Engineering Testing, Inc. (AET) to conduct a subsurface exploration program at the site, conduct soil laboratory testing, and perform a geotechnical engineering review for the project. This report presents the results of the above services, and provides our engineering recommendations based on this data.

2.0 SCOPE OF SERVICES

AET's services were performed according to our proposal to you dated June 23, 2011, which you authorized on June 29, 2011. The authorized scope consists of the following:

- Eight standard penetration test borings, each to a 20 foot depth.
- Soil laboratory testing.
- Geotechnical engineering analysis based on the gained data and preparation of this report.

These services are intended for geotechnical purposes. The scope is not intended to explore for the presence or extent of environmental contamination.

3.0 PROJECT INFORMATION

We understand that the project includes 5 lots in an industrial park in Isanti, Minnesota. We have no information regarding the structures at this time. For the purposes of this report we are assuming that the buildings will be single story, slab on grade buildings. We assume that the buildings will have wall loads on the order of 6 to 8 kips per lineal foot and column loads will be less than 150 kips. As the lots are sold and specific buildings are designed, additional exploration and geotechnical evaluation should be performed for each specific building.

Our foundation design assumptions include a minimum factor of safety of 3 with respect to localized shear or base failure of the foundations. We assume the structures will be able to tolerate total settlements of up to 1 inch, and differential settlements over a 30 foot distance of up to ½ inch.

The above stated information represents our understanding of the proposed construction. This information is an integral part of our engineering review. It is important that you contact us if there are changes from that described so that we can evaluate whether modifications to our recommendations are appropriate.

4.0 SUBSURFACE EXPLORATION AND TESTING

4.1 Field Exploration Program

The subsurface exploration program conducted for the project consisted of eight standard penetration test borings. The logs of the borings and details of the methods used appear in Appendix A. The logs contain information concerning soil layering, soil classification, geologic description, and moisture condition. Relative density or consistency is also noted for the natural soils, which is based on the standard penetration resistance (N-value).

The boring locations are shown on Figure 1 in Appendix A. The borings were located in the field by AET personnel by taping from nearby site features. Surface elevations were measured in the field by Bolton & Menk personnel.

5.0 SITE CONDITIONS

5.1 Surface Observations

The sites are mostly grass and weed covered and mostly fairly level with the exception of the lot where Boring #6 was performed. The lot where Boring #6 was performed has been used as a disposal/storage for excess soils from around the city. This lot is covered with dirt piles from end dump trucks. Some concrete and bituminous pieces are visible on the surface of the piles.

5.2 Subsurface Soils/Geology

The site geology consists of surficial fill over coarse alluvial silty sands and sands.

5.3 Ground Water

Ground water was encountered in all of the borings at depths ranging from 6½ to 9 feet below grade. In soils of this type, the measured water level is generally representative of the water level at the time and location of our drilling. Ground water levels fluctuate due to varying seasonal and annual rainfall and snow melt amounts, as well as other factors.

5.4 Review of Soil Properties

5.4.1 Fill

The majority of the sites contain existing fill deposits. There are no available records indicating the placement methods or compaction testing of the fill. Additional testing should be performed to confirm that it is well-compacted in the planned building areas or if there are records of the fill placement, the records should be reviewed to verify the placement.

Based on the anticipated level of the finished floor relative to the depth of fill found in our borings, it appears that about 2 feet to 4 feet of fill may exist below planned floor levels. As there are lenses of organic soil in the upper portion of the fill, it does not appear that the fill was placed in a controlled manner for structural support. Therefore, we will take the approach that the organic portion of the fill is not acceptable, and we recommend a soil correction procedure in Section 6.1.

5.4.2 Coarse Alluvium

The coarse alluvium is moderate to high strength material and is not judged to be significantly compressible under anticipated fill and building loads. The coarse alluvial soils are moderate to fast draining. The coarse alluvial soils classified as sand and sand with silt are not judged to be significantly frost susceptible. The silty sand coarse alluvial soils are progressively more frost susceptible with an increase in silt content.

6.0 RECOMMENDATIONS

6.1 Building Grading

6.1.1 Excavation

To prepare the building areas for foundation and slab support, we recommend complete excavation of the fill and soils containing organics, thereby exposing the coarse alluvial sands. This would result in excavation depths at the boring locations as shown in Table A.

Table A – Recommended Excavation Depths

Boring Location	Surface Elevation (ft)	Excavation Depth (ft)	Approximate Excavation Elevation (ft)
1	938.3	2-4*	936½-934½*
2	939.1	½-3½*	938½-935½*
3	941.2	½-2*	940½-939*
4	938.9	2	937
5	937.1	2	935
6	937.3	½-2*	937-935½*
7	937.9	2	936
8	938.9	2-4*	937-935*

* The excavation should extend to the deeper depth/lower elevation if the soils encountered are judged to be fill.

The depth/elevation indicated in Table A is based on the soil condition at the specific boring location. Since conditions will vary away from the boring location, it is recommended that AET geotechnical personnel observe and confirm the competency of the soils in the entire excavation bottom prior to new fill or footing placement.

Where the excavation extends below foundation grade, the excavation bottom and resultant engineered fill system must be oversized laterally beyond the planned outside edges of the foundations to properly support the lateral loads exerted by that foundation. This excavation/engineered fill lateral extension should at least be equal to the vertical depth of fill needed to attain foundation grade at that location (i.e., 1:1 lateral oversize).

6.1.2 Fill Placement and Compaction

Prior to placement of new fill, the existing soils should be compacted with several passes of a large self propelled vibratory compactor. Fill placed to attain grade for foundation support should be compacted in thin lifts, such that the entire lift achieves a minimum compaction level of 98% of the standard maximum dry unit weight per ASTM:D698 (Standard Proctor test). Fill placed which supports the floor slab only (outside of the 1:1 oversize zone below footings) can have a reduced minimum compaction level of 95% of the standard maximum dry unit weight.

The majority of the existing fill soils should be re-usable as structural fill for the building and parking areas with the exception of any soils containing organics. The topsoil/organic soil should not be used as structural fill. The silty soils may require moisture conditioning to achieve the recommended compaction levels.

If there are areas where fill is placed on slopes, we recommend benching the sloped surface (benches cut parallel to the slope contour) prior to placing the fill. Benching is recommended where slopes are steeper than 4:1 (H: V).

6.2 Foundation Design

The structure can be supported on conventional spread foundations placed on the natural sands or on newly placed and compacted fill. We recommend perimeter foundations for heated building space is placed such that the bottom is a minimum of 42 inches below exterior grade. We recommend foundations for unheated building space (such as canopy foundations) be extended to a minimum of 60 inches below exterior grade.

Based on the conditions encountered, it is our opinion the building foundations can be designed based on a net maximum allowable soil bearing pressure of 3,000 psf. It is our judgment this design pressure will have a factor of safety of at least 3 against localized shear or base failure. We judge that total settlements under this loading should not exceed 1 inch. We also judge that differential settlements of conditions depicted by the borings should not exceed ½ inch.

6.3 Floor Slab Design

For concrete slab design, we estimate the compacted granular fill should provide a Modulus of Subgrade Reaction (k-value) of at least 225 pci.

For recommendations pertaining to moisture and vapor protection of interior floor slabs, we refer you to the attached standard sheet entitled "Floor Slab Moisture/Vapor Protection."

6.4 Basement Backfilling/Water Control

Our recommendations for backfilling the basement walls and other retaining walls (if there are any) appear on the attached standard sheet entitled "Basement/Retaining Wall Backfill and Water Control." To avoid water intrusion issues into the basement, it will be very important that these details be incorporated into the design, and that construction monitoring be performed to assure that proper materials and construction is implemented.

6.5 Exterior Building Backfilling

Many of the on-site soils are at least moderately frost susceptible. Because of this, certain design considerations are needed to mitigate these frost effects. For details, we refer you to the attached sheet entitled "Freezing Weather Effects on Building Construction."

6.6 Pavements

6.6.1 Subgrade Preparation

We recommend the existing surface vegetation and organic soils in the upper 3 foot of subgrade be removed from below all pavement areas. We anticipate this should result in excavation depths of about 1-2 feet in the new parking areas. After stripping these soils, the exposed soils should be scarified to a depth of about 12 inches; moisture conditioned, and then recompacted to a minimum of 100% of the Standard Proctor maximum dry density. Additional fill placed in the pavement areas should be granular soil compacted to 100% of the Standard Proctor maximum dry density.

6.6.2 Section Thicknesses

We are presenting pavement designs based on two potential traffic situations (light and heavy duty). The light duty design refers to parking areas which are intended only for automobiles and passenger truck/ vans. The heavy duty design is intended for pavements which will experience the heavier truck traffic (9-ton to 10-ton design load). These sections are based on a silty sand subgrade.

Table B – Pavement Thickness Designs

Material	Section Thickness with Silty Sand Subgrade	
	Light Duty	**Heavy Duty**
Bituminous Wear	3" (2 lifts)	2"
Bituminous Non-Wear	0	2"
Class 5 Aggregate Base	6"	8"

7.0 CONSTRUCTION CONSIDERATIONS

7.1 Potential Difficulties

7.1.1 Runoff Water in Excavation

Water can be expected to collect in the excavation bottom during times of inclement weather or snow melt. To allow observation of the excavation bottom, to reduce the potential for soil disturbance, and to facilitate filling operations, we recommend water be removed from within the excavation during construction. Based on the soils encountered, we anticipate the ground water can be handled with conventional sump pumping.

7.1.2 Disturbance of Soils

The on-site soils can become disturbed under construction traffic, especially if the soils are wet. If soils become disturbed, they should be subcut to the underlying undisturbed soils. The subcut soils can then be dried and recompacted back into place, or they should be removed and replaced with drier imported fill.

7.1.3 Cobbles and Boulders

The soils at this site can include cobbles and boulders. This may make excavating procedures somewhat more difficult than normal if they are encountered.

7.2 Excavation Backsloping

If excavation faces are not retained, the excavations should maintain maximum allowable slopes in accordance with *OSHA Regulations (Standards 29 CFR), Part 1926, Subpart P, "Excavations"* (can be found on www.osha.gov). Even with the required OSHA sloping, water seepage or surface runoff can potentially induce sideslope erosion or running which could require slope maintenance.

7.3 Observation and Testing

The recommendations in this report are based on the subsurface conditions found at our test boring locations. Since the soil conditions can be expected to vary away from the soil boring locations, we recommend on-site observation by a geotechnical engineer/technician during construction to evaluate these potential changes. Soil density testing should also be performed on new fill placed in order to document that project specifications for compaction have been satisfied.

8.0 LIMITATIONS

Within the limitations of scope, budget, and schedule, our services have been conducted according to generally accepted geotechnical engineering practices at this time and location.

Other than this, no warranty, either expressed or implied, is intended.

Important information regarding risk management and proper use of this report is given in Appendix B entitled "Geotechnical Report Limitations and Guidelines for Use".

FLOOR SLAB MOISTURE/VAPOR PROTECTION

Floor slab design relative to moisture/vapor protection should consider the type and location of two elements, a granular layer and a vapor membrane (vapor retarder, water resistant barrier or vapor barrier). In the following sections, the pros and cons of the possible options regarding these elements will be presented, such that you and your specifier can make an engineering decision based on the benefits and costs of the choices.

GRANULAR LAYER

In American Concrete Institute (ACI) 302.1R-04, a "base material" is recommended over the vapor membrane, rather than the conventional clean "sand cushion" material. The base layer should be a minimum of 4 inches (100 mm) thick, trimmable, compactable, granular fill (not sand), a so-called crusher-run material. Usually graded from 1½ inches to 2 inches (38 to 50 mm) down to rock dust is suitable. Following compaction, the surface can be choked off with a fine-grade material. We refer you to ACI 302.1R-04 for additional details regarding the requirements for the base material.

In cases where potential static water levels or significant perched water sources appear near or above the floor slab, an under floor drainage system may be needed wherein a draintile system is placed within a thicker clean sand or gravel layer. Such a system should be properly engineered depending on subgrade soil types and rate/head of water inflow.

VAPOR MEMBRANE

The need for a vapor membrane depends on whether the floor slab will have a vapor sensitive covering, will have vapor sensitive items stored on the slab, or if the space above the slab will be a humidity controlled area. If the project does not have this vapor sensitivity or moisture control need, placement of a vapor membrane may not be necessary. Your decision will then relate to whether to use the ACI base material or a conventional sand cushion layer. However, if any of the above sensitivity issues apply, placement of a vapor membrane is recommended. Some floor covering systems (adhesives and flooring materials) require installation of a vapor membrane to limit the slab moisture content as a condition of their warranty.

VAPOR MEMBRANE/GRANULAR LAYER PLACEMENT

A number of issues should be considered when deciding whether to place the vapor membrane above or below the granular layer. The benefits of placing the slab on a granular layer, with the vapor membrane placed **below** the granular layer, include **reduction** of the following:

- Slab curling during the curing and drying process.
- Time of bleeding, which allows for quicker finishing.
- Vapor membrane puncturing.
- Surface blistering or delamination caused by an extended bleeding period.
- Cracking caused by plastic or drying shrinkage.

The benefits of placing the vapor membrane over the granular layer include the following:

- A lower moisture emission rate is achieved faster.
- Eliminates a potential water reservoir within the granular layer above the membrane.
- Provides a "slip surface", thereby reducing slab restraint and the associated random cracking.

If a membrane is to be used in conjunction with a granular layer, the approach recommended depends on slab usage and the construction schedule. The vapor membrane should be placed above the granular layer when:

- Vapor sensitive floor covering systems are used or vapor sensitive items will be directly placed on the slab.
- The area will be humidity controlled, but the slab will be placed before the building is enclosed and sealed from rain.
- Required by a floor covering manufacturer's system warranty.

The vapor membrane should be placed below the granular layer when:

- Used in humidity controlled areas (without vapor sensitive coverings/stored items), with the roof membrane in place, and the building enclosed to the point where precipitation will not intrude into the slab area. Consideration should be given to slight sloping of the membrane to edges where draintile or other disposal methods can alleviate potential water sources, such as pipe or roof leaks, foundation wall damp proofing failure, fire sprinkler system activation, etc.

There may be cases where membrane placement may have a detrimental effect on the subgrade support system (e.g., expansive soils). In these cases, your decision will need to weigh the cost of subgrade options and the performance risks.

BASEMENT/RETAINING WALL BACKFILL AND WATER CONTROL

DRAINAGE

Below-grade basements should include a perimeter backfill drainage system on the exterior side of the wall. The exception may be where basements lie within free draining sands where water will not perch in the backfill. Drainage systems should consist of perforated or slotted PVC drainage pipes located at the bottom of the backfill trench, lower than the interior floor grade. The drain pipe should be surrounded by properly graded filter rock. A filter fabric should then envelope the filter rock. The drain pipe should be connected to a suitable means of disposal, such as a sump basket or a gravity outfall. A storm sewer gravity outfall would be preferred over exterior gravity drainage, as the latter may freeze during winter. For non-building, exterior retaining walls, weep holes at the base of the wall can be substituted for a drain pipe.

BACKFILLING

Prior to backfilling, dampproofing or waterproofing should be applied on perimeter basement walls. The backfill materials placed against basement walls will exert lateral loadings. To reduce this loading by allowing for drainage, we recommend using free draining sands for backfill. The zone of sand backfill should extend outward from the wall at least 2 feet, and then extend upward and outward from the wall at a 30 degree or greater angle from vertical. As a minimum, the sands used on this project should contain no greater than 7% of the particles (by weight) finer than the #200 sieve and no more than 40% of the particles (by weight) finer than the #40 sieve. The sand backfill should be placed in lifts and compacted with portable compaction equipment. This compaction should be to the specified levels if slabs or pavements are placed above. Where slabs or pavements are not above, we recommend capping the sand backfill with a layer of clayey soil to minimize surface water infiltration. Positive surface drainage away from the building should also be maintained. If surface capping or positive surface drainage cannot be maintained, then the trench should be filled with more permeable soils, such as the Fine Filter or Coarse Filter Aggregates defined in MnDOT Specification 3149. You should recognize that if the backfill soils are not properly compacted, settlements may occur which may affect surface drainage away from the building.

Backfilling with silty or clayey soil is possible but not preferred. These soils can build-up water which increases lateral pressures and results in wet wall conditions and possible water infiltration into the basement. If you elect to place silty or clayey soils as backfill, we recommend you place a prefabricated drainage composite against the wall which is hydraulically connected to a drainage pipe at the base of the backfill trench. High plasticity clays should be avoided as backfill due to their swelling potential.

LATERAL PRESSURES

Lateral earth pressures on below-grade walls vary, depending on backfill soil classification, backfill compaction, and slope of the backfill surface. Static or dynamic surcharge loads near the wall will also increase lateral wall pressure. For design, we recommend the following ultimate lateral earth pressure values (given in equivalent fluid pressure values) for a drained soil compacted to 95% of the Standard Proctor density and a level ground surface.

	Equivalent Fluid Density	
Soil Type	**Active Pressure (pcf)**	**At-Rest Pressure (pcf)**
Sands (SP or SP-SM)	35	50
Silty Sands (SM	45	65
Fine Grained Soils (SC, CL or ML)	70	90

Basement walls are normally restrained at the top which restricts movement. In this case, the design lateral pressures should be the "at-rest" pressure situation. Retaining walls which are free to rotate or deflect should be designed using the active case. Lateral earth pressures will be significantly higher than that shown if the backfill soils are not drained and become saturated.

FREEZING WEATHER EFFECTS ON BUILDING CONSTRUCTION

GENERAL

Because water expands upon freezing and soils contain water, soils which are allowed to freeze will heave and lose density. Upon thawing, these soils will not regain their original strength and density. The extent of heave and density/ strength loss depends on the soil type and moisture condition. Heave is greater in soils with higher percentages of fines (silts/clays). High silt content soils are most susceptible, due to their high capillary rise potential which can create ice lenses. Fine grained soils generally heave about 1/4" to 3/8" for each foot of frost penetration. This can translate to 1" to 2" of total frost heave. This total amount can be significantly greater if ice lensing occurs.

DESIGN CONSIDERATIONS

Clayey and silty soils can be used as perimeter backfill, although the effect of their poor drainage and frost properties should be considered. Basement areas will have special drainage and lateral load requirements which are not discussed here. Frost heave may be critical in doorway areas. Stoops or sidewalks adjacent to doorways could be designed as structural slabs supported on frost footings with void spaces below. With this design, movements may then occur between the structural slab and the adjacent on-grade slabs. Non-frost susceptible sands (with less than 12% passing a #200 sieve) can be used below such areas. Depending on the function of surrounding areas, the sand layer may need a thickness transition away from the area where movement is critical. With sand placement over slower draining soils, subsurface drainage would be needed for the sand layer. High density extruded insulation could be used within the sand to reduce frost penetration, thereby reducing the sand thickness needed. We caution that insulation placed near the surface can increase the potential for ice glazing of the surface.

The possible effects of adfreezing should be considered if clayey or silty soils are used as backfill. Adfreezing occurs when backfill adheres to rough surfaced foundation walls and lifts the wall as it freezes and heaves. This occurrence is most common with masonry block walls, unheated or poorly heated building situations and clay backfill. The potential is also increased where backfill soils are poorly compacted and become saturated. The risk of adfreezing can be decreased by placing a low friction separating layer between the wall and backfill.

Adfreezing can occur on exterior piers (such as deck, fence or other similar pier footings), even if a smooth surface is provided. This is more likely in poor drainage situations where soils become saturated. Additional footing embedment and/or widened footings below the frost zones (which include tensile reinforcement) can be used to resist uplift forces. Specific designs would require individual analysis.

CONSTRUCTION CONSIDERATIONS

Foundations, slabs and other improvements which may be affected by frost movements should be insulated from frost penetration during freezing weather. If filling takes place during freezing weather, all frozen soils, snow and ice should be stripped from areas to be filled prior to new fill placement. The new fill should not be allowed to freeze during transit, placement or compaction. This should be considered in the project scheduling, budgeting and quantity estimating. It is usually beneficial to perform cold weather earthwork operations in small areas where grade can be attained quickly rather than working larger areas where a greater amount of frost stripping may be needed. If slab subgrade areas freeze, we recommend the subgrade be thawed prior to floor slab placement. The frost action may also require reworking and recompaction of the thawed subgrade.

Appendix A

AET Project No. 26-00389

Geotechnical Field Exploration and Testing
Boring Log Notes
Unified Soil Classification System
Figure 1 – Boring Locations
Subsurface Boring Logs

Appendix A
Geotechnical Field Exploration and Testing
AET Project No. 26-00389

A.1 FIELD EXPLORATION

The subsurface conditions at the site were explored by drilling and sampling eight (8) standard penetration test borings. The locations of the borings appear on Figure 1, preceding the Subsurface Boring Logs in this appendix.

A.2 SAMPLING METHODS

A.2.1 Split-Spoon Samples (SS) - Calibrated to N_{60} Values

Standard penetration (split-spoon) samples were collected in general accordance with ASTM: D1586 with one primary modification. The ASTM test method consists of driving a 2-inch O.D. split-barrel sampler into the in-situ soil with a 140-pound hammer dropped from a height of 30 inches. The sampler is driven a total of 18 inches into the soil. After an initial set of 6 inches, the number of hammer blows to drive the sampler the final 12 inches is known as the standard penetration resistance or N-value. Our method uses a modified hammer weight, which is determined by measuring the system energy using a Pile Driving Analyzer (PDA) and an instrumented rod.

In the past, standard penetration N-value tests were performed using a rope and cathead for the lift and drop system. The energy transferred to the split-spoon sampler was typically limited to about 60% of its potential energy due to the friction inherent in this system. This converted energy then provides what is known as an N_{60} blow count.

The most recent drill rigs incorporate an automatic hammer lift and drop system, which has higher energy efficiency and subsequently results in lower N-values than the traditional N_{60} values. By using the PDA energy measurement equipment, we are able to determine actual energy generated by the drop hammer. With the various hammer systems available, we have found highly variable energies ranging from 55% to over 100%. Therefore, the intent of AET's hammer calibrations is to vary the hammer weight such that hammer energies lie within about 60% to 65% of the theoretical energy of a 140-pound weight falling 30 inches. The current ASTM procedure acknowledges the wide variation in N-values, stating that N-values of 100% or more have been observed. Although we have not yet determined the statistical measurement uncertainty of our calibrated method to date, we can state that the accuracy deviation of the N-values using this method is significantly better than the standard ASTM Method.

A.2.2 Disturbed Samples (DS)/Spin-up Samples (SU)

Sample types described as "DS" or "SU" on the boring logs are disturbed samples, which are taken from the flights of the auger. Because the auger disturbs the samples, possible soil layering and contact depths should be considered approximate.

A.2.3 Sampling Limitations

Unless actually observed in a sample, contacts between soil layers are estimated based on the spacing of samples and the action of drilling tools. Cobbles, boulders, and other large objects generally cannot be recovered from test borings, and they may be present in the ground even if they are not noted on the boring logs.

Determining the thickness of "topsoil" layers is usually limited, due to variations in topsoil definition, sample recovery, and other factors. Visual-manual description often relies on color for determination, and transitioning changes can account for significant variation in thickness judgment. Accordingly, the topsoil thickness presented on the logs should not be the sole basis for calculating topsoil stripping depths and volumes. If more accurate information is needed relating to thickness and topsoil quality definition, alternate methods of sample retrieval and testing should be employed.

A.3 CLASSIFICATION METHODS

Soil descriptions shown on the boring logs are based on the Unified Soil Classification (USC) system. The USC system is described in ASTM: D2487 and D2488. Where laboratory classification tests (sieve analysis or Atterberg Limits) have been performed, accurate classifications per ASTM: D2487 are possible. Otherwise, soil descriptions shown on the boring logs are visual-manual judgments. Charts are attached which provide information on the USC system, the descriptive terminology, and the symbols used on the boring logs.

Visual-manual judgment of the AASHTO Soil Group is also noted as a part of the soil description. A chart presenting details of the AASHTO Soil Classification System is also attached.

The boring logs include descriptions of apparent geology. The geologic depositional origin of each soil layer is interpreted primarily by observation of the soil samples, which can be limited. Observations of the surrounding topography, vegetation, and development can sometimes aid this judgment.

A.4 WATER LEVEL MEASUREMENTS

The ground water level measurements are shown at the bottom of the boring logs. The following information appears under "Water Level Measurements" on the logs:

- Date and Time of measurement
- Sampled Depth: lowest depth of soil sampling at the time of measurement
- Casing Depth: depth to bottom of casing or hollow-stem auger at time of measurement
- Cave-in Depth: depth at which measuring tape stops in the borehole
- Water Level: depth in the borehole where free water is encountered
- Drilling Fluid Level: same as Water Level, except that the liquid in the borehole is drilling fluid

The true location of the water table at the boring locations may be different than the water levels measured in the boreholes. This is possible because there are several factors that can affect the water level measurements in the borehole. Some of these factors include: permeability of each soil layer in profile, presence of perched water, amount of time between water level readings, presence of drilling fluid, weather conditions, and use of borehole casing.

A.5 LABORATORY TEST METHODS

A.5.1 Water Content Tests
Conducted per AET Procedure 01-LAB-010, which is performed in general accordance with ASTM: D2216 and AASHTO: T265.

A.5.2 Atterberg Limits Tests
Conducted per AET Procedure 01-LAB-030, which is performed in general accordance with ASTM: D4318 and AASHTO: T89, T90.

A.5.3 Sieve Analysis of Soils (thru #200 Sieve)
Conducted per AET Procedure 01-LAB-040, which is performed in general conformance with ASTM: D6913, Method A.

A.5.4 Particle Size Analysis of Soils (with hydrometer)
Conducted per AET Procedure 01-LAB-050, which is performed in general accordance with ASTM: D422 and AASHTO: T88.

A.5.5 Unconfined Compressive Strength of Cohesive Soil
Conducted per AET Procedure 01-LAB-080, which is performed in general accordance with ASTM: D2166 and AASHTO: T208.

A.5.6 Laboratory Soil Resistivity using the Wenner Four-Electrode Method
Conducted per AET Procedure 01-LAB-090, which is performed using Soil Box apparatus in the laboratory in general accordance with ASTM: G57

A.6 TEST STANDARD LIMITATIONS

Field and laboratory testing is done in general conformance with the described procedures. Compliance with any other standards referenced within the specified standard is neither inferred nor implied.

A.7 SAMPLE STORAGE

Unless notified to do otherwise, we routinely retain representative samples of the soils recovered from the borings for a period of 30 days.

BORING LOG NOTES

DRILLING AND SAMPLING SYMBOLS

Symbol	Definition
B, H, N:	Size of flush-joint casing
CA:	Crew Assistant (initials)
CAS:	Pipe casing, number indicates nominal diameter in inches
CC:	Crew Chief (initials)
COT:	Clean-out tube
DC:	Drive casing; number indicates diameter in inches
DM:	Drilling mud or bentonite slurry
DR:	Driller (initials)
DS:	Disturbed sample from auger flights
FA:	Flight auger; number indicates outside diameter in inches
HA:	Hand auger; number indicates outside diameter
HSA:	Hollow stem auger; number indicates inside diameter in inches
LG:	Field logger (initials)
MC:	Column used to describe moisture condition of samples and for the ground water level symbols
N (BPF):	Standard penetration resistance (N-value) in blows per foot (see notes)
NQ:	NQ wireline core barrel
PQ:	PQ wireline core barrel
RD:	Rotary drilling with fluid and roller or drag bit
REC:	In split-spoon (see notes) and thin-walled tube sampling, the recovered length (in inches) of sample. In rock coring, the length of core recovered (expressed as percent of the total core run). Zero indicates no sample recovered.
REV:	Revert drilling fluid
SS:	Standard split-spoon sampler (steel; 1⅜" is inside diameter; 2" outside diameter); unless indicated otherwise
SU	Spin-up sample from hollow stem auger
TW:	Thin-walled tube; number indicates inside diameter in inches
WASH:	Sample of material obtained by screening returning rotary drilling fluid or by which has collected inside the borehole after "falling" through drilling fluid
WH:	Sampler advanced by static weight of drill rod and hammer
WR:	Sampler advanced by static weight of drill rod
94mm:	94 millimeter wireline core barrel
▼:	Water level directly measured in boring
▽:	Estimated water level based solely on sample appearance

TEST SYMBOLS

Symbol	Definition
CONS:	One-dimensional consolidation test
DEN:	Dry density, pcf
DST:	Direct shear test
E:	Pressuremeter Modulus, tsf
HYD:	Hydrometer analysis
LL:	Liquid Limit, %
LP:	Pressuremeter Limit Pressure, tsf
OC:	Organic Content, %
PERM:	Coefficient of permeability (K) test; F - Field; L - Laboratory
PL:	Plastic Limit, %
q_p:	Pocket Penetrometer strength, tsf (approximate)
q_c:	Static cone bearing pressure, tsf
q_u:	Unconfined compressive strength, psf
R:	Electrical Resistivity, ohm-cms
RQD:	Rock Quality Designation of Rock Core, in percent (aggregate length of core pieces 4" or more in length as a percent of total core run)
SA:	Sieve analysis
TRX:	Triaxial compression test
VSR:	Vane shear strength, remolded (field), psf
VSU:	Vane shear strength, undisturbed (field), psf
WC:	Water content, as percent of dry weight
%-200:	Percent of material finer than #200 sieve

STANDARD PENETRATION TEST NOTES
(Calibrated Hammer Weight)

The standard penetration test consists of driving a split-spoon sampler with a drop hammer (calibrated weight varies to provide N_{60} values) and counting the number of blows applied in each of three 6" increments of penetration. If the sampler is driven less than 18" (usually in highly resistant material), permitted in ASTM: D1586, the blows for each complete 6" increment and for each partial increment is on the boring log. For partial increments, the number of blows is shown to the nearest 0.1' below the slash.

The length of sample recovered, as shown on the "REC" column, may be greater than the distance indicated in the N column. The disparity is because the N-value is recorded below the initial 6" set (unless partial penetration defined in ASTM: D1586 is encountered) whereas the length of sample recovered is for the entire sampler drive (which may even extend more than 18").

UNIFIED SOIL CLASSIFICATION SYSTEM
ASTM Designations: D 2487, D2488

AMERICAN ENGINEERING TESTING, INC.

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification: Group Symbol	Soil Classification: Group Name[B]
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$[E]	GW	Well graded gravel[F]
			$Cu < 4$ and/or $1 > Cc > 3$[E]	GP	Poorly graded gravel[F]
		Gravels with Fines more than 12% fines[C]	Fines classify as ML or MH	GM	Silty gravel[F,G,H]
			Fines classify as CL or CH	GC	Clayey gravel[F,G,H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]	SW	Well-graded sand[I]
			$Cu < 6$ and/or $1 > Cc > 3$[E]	SP	Poorly-graded sand[I]
		Sands with Fines more than 12% fines[D]	Fines classify as ML or MH	SM	Silty sand[G,H,I]
			Fines classify as CL or CH	SC	Clayey sand[G,H,I]
Fine-Grained Soils 50% or more passes the No. 200 sieve (see Plasticity Chart below)	Silts and Clays Liquid limit less than 50	inorganic	PI>7 and plots on or above "A" line[J]	CL	Lean clay[K,L,M]
			PI<4 or plots below "A" line[J]	ML	Silt[K,L,M]
		organic	$\frac{\text{Liquid limit – oven dried}}{\text{Liquid limit – not dried}} < 0.75$	OL	Organic clay[K,L,M,N] Organic silt[K,L,M,O]
	Silts and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line	CH	Fat clay[K,L,M]
			PI plots below "A" line	MH	Elastic silt[K,L,M]
		organic	$\frac{\text{Liquid limit – oven dried}}{\text{Liquid limit – not dried}} < 0.75$	OH	Organic clay[K,L,M,P] Organic silt[K,L,M,Q]
Highly organic soil			Primarily organic matter, dark in color, and organic in odor	PT	Peat[R]

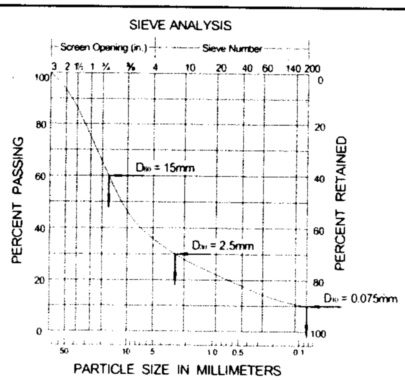
Notes

[A]Based on the material passing the 3-in (75-mm) sieve.
[B]If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C]Gravels with 5 to 12% fines require dual symbols:
- GW-GM well-graded gravel with silt
- GW-GC well-graded gravel with clay
- GP-GM poorly graded gravel with silt
- GP-GC poorly graded gravel with clay

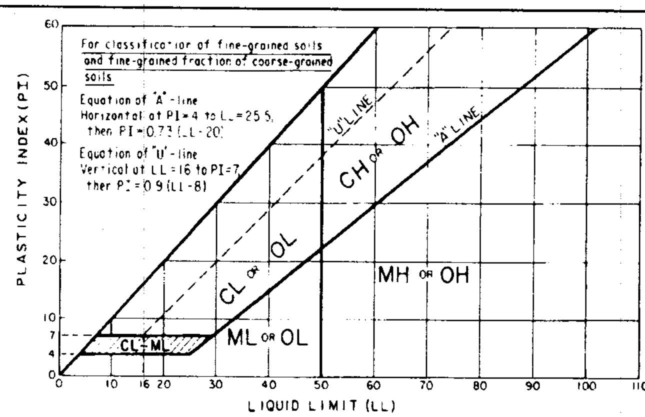
[D]Sands with 5 to 12% fines require dual symbols:
- SW-SM well-graded sand with silt
- SW-SC well-graded sand with clay
- SP-SM poorly graded sand with silt
- SP-SC poorly graded sand with clay

[E]$Cu = D_{60} / D_{10}$, $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[F]If soil contains ≥15% sand, add "with sand" to group name.
[G]If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H]If fines are organic, add "with organic fines" to group name.
[I]If soil contains ≥15% gravel, add "with gravel" to group name.
[J]If Atterberg limits plot is hatched area, soils is a CL-ML silty clay.
[K]If soil contains 15 to 29% plus No. 200 add "with sand" or "with gravel", whichever is predominant.
[L]If soil contains ≥30% plus No. 200, predominantly sand, add "sandy" to group name.
[M]If soil contains ≥30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N]PI≥4 and plots on or above "A" line.
[O]PI<4 or plots below "A" line.
[P]PI plots on or above "A" line.
[Q]PI plots below "A" line.
[R]Fiber Content description shown below.



$C_u = \frac{D_{60}}{D_{10}} = \frac{15}{0.075} = 200$ $\quad C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = \frac{2.5^2}{0.075 \times 15} = 5.6$



Plasticity Chart

ADDITIONAL TERMINOLOGY NOTES USED BY AET FOR SOIL IDENTIFICATION AND DESCRIPTION

Grain Size

Term	Particle Size
Boulders	Over 12"
Cobbles	3" to 12"
Gravel	#4 sieve to 3"
Sand	#200 to #4 sieve
Fines (silt & clay)	Pass #200 sieve

Gravel Percentages

Term	Percent
A Little Gravel	3% - 14%
With Gravel	15% - 29%
Gravelly	30% - 50%

Consistency of Plastic Soils

Term	N-Value, BPF
Very Soft	less than 2
Soft	2 - 4
Firm	5 - 8
Stiff	9 - 15
Very Stiff	16 - 30
Hard	Greater than 30

Relative Density of Non-Plastic Soils

Term	N-Value, BPF
Very Loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	Greater than 50

Moisture/Frost Condition
(MC Column)

D (Dry):	Absense of moisture, dusty, dry to touch.
M (Moist):	Damp, although free water not visible. Soil may still have a high water content (over "optimum").
W (Wet/ Waterbearing):	Free water visible intended to describe non-plastic soils. Waterbearing usually relates to sands and sand with silt.
F (Frozen):	Soil frozen

Layering Notes

Laminations:	Layers less than ½" thick of differing material or color.
Lenses:	Pockets or layers greater than ½" thick of differing material or color.

Peat Description

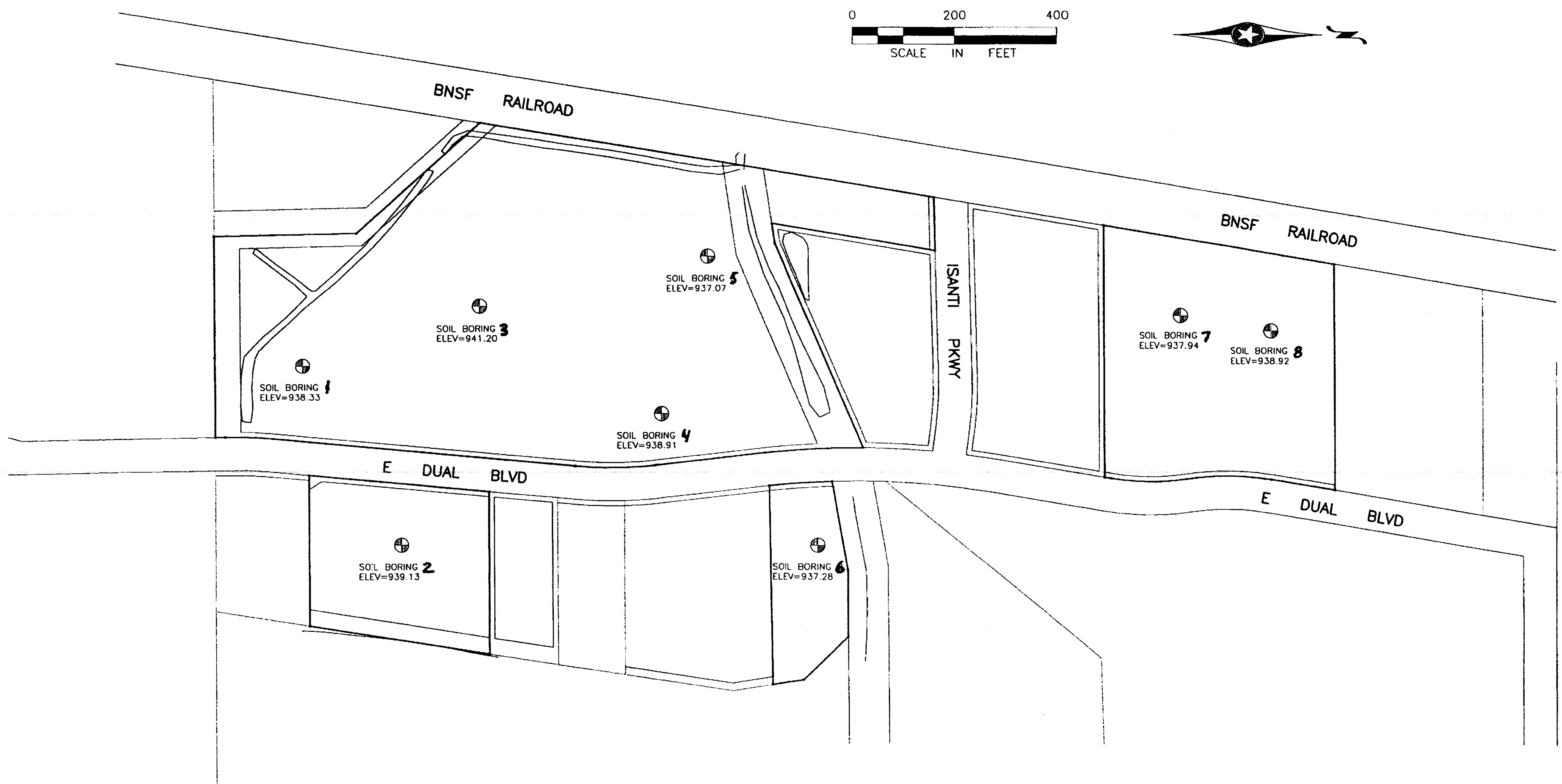
Term	Fiber Content (Visual Estimate)
Fibric Peat:	Greater than 67%
Hemic Peat:	33 – 67%
Sapric Peat:	Less than 33%

Organic Description (if no lab tests)

Soils are described as *organic*, if soil is not peat and is judged to have sufficient organic fines content to influence the Liquid Limit properties. *Slightly organic* used for borderline cases.

Root Inclusions

With roots:	Judged to have sufficient quantity of roots to influence the soil properties.
Trace roots:	Small roots present, but not judged to be in sufficient quantity to significantly affect soil properties.



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SOIL BORINGS
CITY OF ISANTI

CENTENNIAL
INDUSTRIAL
PARK

FOR: CITY OF ISANTI

BOLTON & MENK, INC.
Consulting Engineers & Surveyors
7533 SUNWOOD DRIVE, RAMSEY, MN 55303 (763) 433-2851
MANKATO, MN FAIRMONT, MN SLEEPY EYE, MN BURNSVILLE, MN
WILLMAR, MN CHASKA, MN RAMSEY, MN AMES, IA

JOB NUMBER: R13103692 FIELD BOOK: ISANTI 01 DRAWN BY: JGM

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET JOB NO: **26-00389** LOG OF BORING NO. **1 (p. 1 of 1)**

PROJECT: **Centennial Industrial Park, Isanti Parkway & East Dual Boulevard; Isanti, MN**

SURFACE ELEVATION: **938.3**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	%-#200
0-2	SILTY SAND, trace roots, fine grained, dark brown, a little black, moist, loose, a lens of silty sand with organic fines (SM) (possible fill)	COARSE ALLUVIUM OR FILL	7	M	SS	18					
2-4	SILTY SAND, fine grained, light brownish gray and brown mottled, moist, loose (SM) (possible fill)		8	M	SS	18					
4-6.5	SILTY SAND, fine grained, brown and light brownish gray mottled, moist to wet (SM)	COARSE ALLUVIUM	14	M/W	SS	18					
6.5-21	SAND, fine grained; light brownish gray to gray, moist to about 8' then waterbearing, medium dense to loose (SP)		12	M/W	SS	15					
			8	W	SS	13					
			12	W	SS	16					
			12	W	SS	18					
			9	W	SS	16					

END OF BORING

DEPTH:	DRILLING METHOD
0-9½'	3.25" HSA
9½-19½'	RD w/DM

BORING COMPLETED: 7/13/11

DR: TA LG: EW Rig: 69C

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/13/11	9:00	11.0	9.5	9.5		8.0

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 26-00389.GPJ AET+CPT+WELL.GDT 7/21/11

03/2011

01-DHR-060

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET JOB NO: **26-00389** LOG OF BORING NO. **2 (p. 1 of 1)**

PROJECT: **Centennial Industrial Park, Isanti Parkway & East Dual Boulevard; Isanti, MN**

DEPTH IN FEET	SURFACE ELEVATION: 939.1 MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	%-#200
1	SILTY SAND, a little gravel, trace roots, fine grained, dark brown, moist, very loose to loose (SM) (possible fill)	COARSE ALLUVIUM OR FILL	4	M	SS	13					
2											
3			7	M	SS	12					
4	SAND WITH SILT, fine grained, light brown to brown and gray mottled, moist, medium dense, a lens of lean clay (SP-SM)	COARSE ALLUVIUM									
5			12	M	SS	14					
6											
7											
8			12	M	SS	16					
9	SAND, fine grained, brownish gray and brown mottled, waterbearing, loose to medium dense (SP)										
10			10	M/W	SS	13					
11											
12											
13			8	W	SS	13					
14											
15			11	W	SS	13					
16											
17											
18											
19											
20			18	W	SS	13					
21	**END OF BORING**										

DEPTH:	DRILLING METHOD
0-9½'	**3.25" HSA**
9½-19½'	**RD w/DM**

BORING COMPLETED: **7/14/11**

DR: **TA** LG: **EW** Rig: **69C**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/14/11	**10:50**	**11.0**	**9.5**	**9.5**		**7.5**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET JOB NO: **26-00389** LOG OF BORING NO. **3 (p. 1 of 1)**

PROJECT: **Centennial Industrial Park, Isanti Parkway & East Dual Boulevard; Isanti, MN**

DEPTH IN FEET	SURFACE ELEVATION: 941.2 MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	%-#200
0–2	SILTY SAND, trace roots, fine grained, light grayish brown, moist, very loose (SM) (possible fill)	COARSE ALLUVIUM OR FILL	2	M	SS	13					
2–3.5	SILTY SAND, fine grained, brown mottled, moist, loose (SM)	COARSE ALLUVIUM	9	M	SS	14					
3.5–9	SILTY SAND, fine grained, light grayish brown to light brownish gray, moist, medium dense to loose (SM)		12	M	SS	17					
			9	M	SS	18					
9–11.5	SAND, fine grained, brownish gray, waterbearing, loose (SP)		10	W	SS	14					
11.5–14	SAND, fine to medium grained, brownish gray, waterbearing, loose (SP)		10	W	SS	14					
14–18	SAND WITH SILT, fine grained, brownish gray, waterbearing, medium dense (SP-SM)		11	W	SS	16					
18–21	SAND, fine grained, brownish gray, waterbearing, loose (SP)		9	W	SS	13					
21	**END OF BORING**										

DEPTH:	DRILLING METHOD
0-9½'	3.25" HSA
9½-19½'	RD w/DM

BORING COMPLETED: 7/13/11

DR: TA LG: EW Rig: 69C

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/13/11	10:00	11.0	9.5	10.1		9.5

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET JOB NO: **26-00389**　　LOG OF BORING NO. **4 (p. 1 of 1)**

PROJECT: **Centennial Industrial Park, Isanti Parkway & East Dual Boulevard; Isanti, MN**

SURFACE ELEVATION: **938.9**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	%-#200
0–2	SILTY SAND, trace roots, fine grained, brown and dark brown, moist, loose, a lens of silty sand with organic fines (SM) (possible fill)	COARSE ALLUVIUM OR FILL	6	M	SS	15					
2–6.5	SAND WITH SILT, trace roots, fine grained, light brownish gray and brown mottled, moist, medium dense, lenses and laminations of silty sand (SP-SM)	COARSE ALLUVIUM	12	M	SS	15					
			11	M	SS	15					
6.5–9	SAND, fine grained, brownish gray and brown mottled, moist to about 7.5' then waterbearing, loose (SP)		9	M/W	SS	15					
9–18	SAND, fine to medium grained, brownish gray, a little light brown, waterbearing, loose, lenses of fine grained sand (SP)		10	W	SS	14					
			8	W	SS	14					
			7	W	SS	16					
18–21	SAND, fine grained, brownish gray, waterbearing, loose (SP)		10	W	SS	16					
21	**END OF BORING**										

DEPTH:	DRILLING METHOD
0-9½'	3.25" HSA
9½-19½'	RD w/DM

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/13/11	12:00	8.5	7.0	7.5		7.8

BORING COMPLETED: 7/13/11

DR: TA　LG: EW　Rig: 69C

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 26-00389.GPJ AET+CPT+WELL.GDT 7/21/11

03/2011

01-DHR-060

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET JOB NO: **26-00389** LOG OF BORING NO. **5 (p. 1 of 1)**

PROJECT: **Centennial Industrial Park, Isanti Parkway & East Dual Boulevard; Isanti, MN**

SURFACE ELEVATION: **937.1**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	%-#200
0–2	SILTY SAND, trace roots, fine grained, brownish gray, a little black, moist, very loose, a lens of silty sand with organic fines (SM) (possible fill)	COARSE ALLUVIUM OR FILL	4	M	SS	16					
2–3.5	SILTY SAND, fine grained, light brownish gray, moist, loose (SM)	COARSE ALLUVIUM	7	M	SS	15					
3.5–6.5	SAND WITH SILT, fine grained, light brownish gray and brown mottled, moist to waterbearing, loose (SP-SM)		10	M/W	SS	16					
6.5–9	SAND, fine grained, light grayish brown, waterbearing, loose (SP)		8	W	SS	14					
9–14	SAND WITH SILT, fine grained, gray and brown mottled to light grayish brown, waterbearing, loose to medium dense (SP-SM)		9	W	SS	15					
			12	W	SS	15					
14–18	SAND, fine to medium grained, brown, waterbearing, loose (SP)		8	W	SS	13					
18–21	SAND WITH SILT, fine grained, brown, waterbearing, medium dense (SP-SM)		11	W	SS	15					
21	**END OF BORING**										

DEPTH:	DRILLING METHOD
0-7'	3.25" HSA
7-19½'	RD w/DM

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/13/11	11:00	8.5	7.0	7.0		6.5

BORING COMPLETED: **7/13/11**

DR: **TA** LG: **EW** Rig: **69C**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 26-00389.GPJ AET+CPT+WELL.GDT 7/21/11

03/2011

01-DHR-060

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET JOB NO: 26-00389 LOG OF BORING NO. 6 (p. 1 of 1)

PROJECT: Centennial Industrial Park, Isanti Parkway & East Dual Boulevard; Isanti, MN

SURFACE ELEVATION: 937.3

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	%-#200
0-2	SILTY SAND, trace roots, fine grained, brownish gray and brown mottled, moist, loose (SM) (possible fill)	COARSE ALLUVIUM OR FILL	5	M	SS	16					
2-7	SILTY SAND, fine grained, brown to light brownish gray, moist, loose to medium dense (SM)	COARSE ALLUVIUM	10	M	SS	14					
			13	M	SS	15					
7-9	SAND WITH SILT, fine grained, brown and brownish gray mottled, waterbearing, loose (SP-SM)		6	W	SS	12					
9-14	SAND, fine grained, light brownish gray to gray, waterbearing, loose (SP)		7	W	SS	13					
			9	W	SS	14					
14-21	SAND, fine to medium grained, brownish gray to gray, waterbearing, loose (SP)		8	W	SS	14					
			9	W	SS	15					
21	END OF BORING										

DEPTH:	DRILLING METHOD
0-7'	3.25" HSA
7-19½'	RD w/DM

BORING COMPLETED: 7/14/11

DR: TA LG: EW Rig: 69C

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/14/11	9:45	8.5	7.0	7.0		6.5

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 26-00389.GPJ AET+CPT+WELL.GDT 7/21/11

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET JOB NO: **26-00389** LOG OF BORING NO. **7 (p. 1 of 1)**

PROJECT: **Centennial Industrial Park, Isanti Parkway & East Dual Boulevard; Isanti, MN**

SURFACE ELEVATION: **937.9**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	%-#200
0–2	SILTY SAND, trace roots, fine grained, grayish brown to light grayish brown, moist, loose, a lens of silty sand with organic fines (SM) (possible fill)	COARSE ALLUVIUM OR FILL	5	M	SS	14					
2–4	SAND WITH SILT, trace roots, fine grained, light brownish gray, a little brown and brownish gray, moist, loose (SP-SM)	COARSE ALLUVIUM	6	M	SS	15					
4–18	SAND WITH SILT, fine grained, brown mottled to light brownish gray, moist to about 6.5' then waterbearing, loose (SP-SM)		9	M	SS	15					
			6	W	SS	12					
			6	W	SS	12					
			5	W	SS	12					
			6	W	SS	14					
18–21	SAND WITH SILT, fine to medium grained, brownish gray, waterbearing, loose, a lens of fine grained sand (SP-SM)		9	W	SS	15					
21	**END OF BORING**										

DEPTH:	DRILLING METHOD
0-7'	3.25" HSA
7-19½'	RD w/DM

BORING COMPLETED: 7/13/11

DR: **TA** LG: **EW** Rig: **69C**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/13/11	1:00	8.5	7.0	7.0		6.5

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 26-00389.GPJ AET+CPT+WELL.GDT 7/21/11

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET JOB NO: **26-00389** LOG OF BORING NO. **8 (p. 1 of 1)**

PROJECT: **Centennial Industrial Park, Isanti Parkway & East Dual Boulevard; Isanti, MN**

SURFACE ELEVATION: 938.9

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	%-#200
0–2	FILL, mixture of sand and sand with silt, trace roots, light brownish gray and light brown	FILL	6	M	SS	13					
2–4	SILTY SAND, trace roots, fine grained, dark brown, a little light brownish gray, moist, medium dense (SM) (possible fill)	COARSE ALLUVIUM OR FILL	11	M	SS	17					
4–21	SAND WITH SILT, fine grained, brown and brownish gray mottled to light grayish brown, moist to about 7' then waterbearing, loose (SP-SM)	COARSE ALLUVIUM	9	M	SS	16					
			8	W	SS	15					
			9	W	SS	16					
			10	W	SS	16					
			8	W	SS	16					
			7	W	SS	16					
21	**END OF BORING**										

DEPTH:	DRILLING METHOD
0-7'	**3.25" HSA**
7-19½'	**RD w/DM**

BORING COMPLETED: **7/14/11**

DR: **TA** LG: **EW** Rig: **69C**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/14/11	8:45	8.5	7.0	7.4		7.0

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

Appendix B

AET Project No. 26-00389

Geotechnical Report Limitations and Guidelines for Use

Appendix B
Geotechnical Report Limitations and Guidelines for Use
AET Project No. 26-00389

B.1 REFERENCE

This appendix provides information to help you manage your risks relating to subsurface problems which are caused by construction delays, cost overruns, claims, and disputes. This information was developed and provided by ASFE[1], of which, we are a member firm.

B.2 RISK MANAGEMENT INFORMATION

B.2.1 Geotechnical Services are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared solely for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. And no one, not even you, should apply the report for any purpose or project except the one originally contemplated.

B.2.2 Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

B.2.3 A Geotechnical Engineering Report is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typically factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, always inform your geotechnical engineer of project changes, even minor ones, and request an assessment of their impact. Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.

B.2.4 Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. Do not rely on a geotechnical engineering report whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. Always contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

1 ASFE, 8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733: www.asfe.org

B.2.5 Most Geotechnical Findings Are Professional Opinions
Site exploration identified subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ, sometimes significantly, from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

B.2.6 A Report's Recommendations Are Not Final
Do not overrely on the construction recommendations included in your report. Those recommendations are not final, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.

B.2.7 A Geotechnical Engineering Report Is Subject to Misinterpretation
Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

B.2.8 Do Not Redraw the Engineer's Logs
Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should never be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, but recognizes that separating logs from the report can elevate risk.

B.2.9 Give Contractors a Complete Report and Guidance
Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, but preface it with a clearly written letter of transmittal. In the letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. Be sure contractors have sufficient time to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

B.2.10 Read Responsibility Provisions Closely
Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their report. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. Read these provisions closely. Ask questions. Your geotechnical engineer should respond fully and frankly.

B.2.11 Geoenvironmental Concerns Are Not Covered
The equipment, techniques, and personnel used to perform a geoenvironmental study differ significantly from those used to perform a geotechnical study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Unanticipated environmental problems have led to numerous project failures. If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. Do not rely on an environmental report prepared for someone else.